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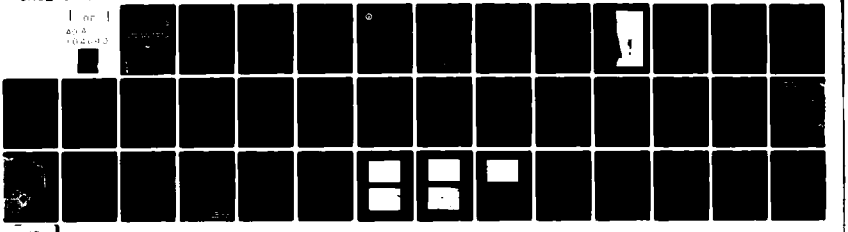

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RUSTIC HILLS LAKE DAM
JEFFERSON COUNTY, MISSOURI
MO 30467

PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

PREPARED BY: U. S. ARMY ENGINEER DISTRICT, ST. LOUIS

FOR: STATE OF MISSOURI

SEPTEMBER 1978

UNCLASSIFIED
SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE	READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER	2. GOVT ACCESSION NO. AD-A104 680	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Phase I Dam Inspection Report National Dam Safety Program Rustic Hills Lake Dam (MO 30467) Jefferson County, Missouri	5. TYPE OF REPORT & PERIOD COVERED Final Report
	6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) Horner & Shifrin, Inc.	8. CONTRACT OR GRANT NUMBER(s) DACW43-78-C-0143
9. PERFORMING ORGANIZATION NAME AND ADDRESS U.S. Army Engineer District, St. Louis Dam Inventory and Inspection Section, LMSED-PD 210 Tucker Blvd., North, St. Louis, Mo. 63101	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS U.S. Army Engineer District, St. Louis Dam Inventory and Inspection Section, LMSED-PD 210 Tucker Blvd., North, St. Louis, Mo. 63101	12. REPORT DATE September 1978
	13. NUMBER OF PAGES Approximately 30
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office)	15. SECURITY CLASS. (of this report) UNCLASSIFIED
	15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for release; distribution unlimited.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Dam Safety, Lake, Dam Inspection, Private Dams

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report was prepared under the National Program of Inspection of Non-Federal Dams. This report assesses the general condition of the dam with respect to safety, based on available data and on visual inspection, to determine if the dam poses hazards to human life or property.

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DEPARTMENT OF THE ARMY
ST. LOUIS DISTRICT, CORPS OF ENGINEERS
210 NORTH 12TH STREET
ST. LOUIS, MISSOURI 63101

IN REPLY REFER TO

(1)

SUBJECT: Rustic Hills Dam Phase I Inspection Report

This report presents the results of field inspection and evaluation of the Rustic Hills Dam. It was prepared under the National Program of Inspection of Non-Federal Dams.

SUBMITTED BY: SIGNED
Chief, Engineering Division

29 SEP 1978
Date

APPROVED BY: SIGNED
Colonel, CE, District Engineer

29 SEP 1978
Date

DEPARTMENT OF THE ARMY
ST. LOUIS DISTRICT, CORPS OF ENGINEERS
210 NORTH 12TH STREET
ST. LOUIS, MISSOURI 63101

SUBJECT: Rustic Hills Lake Dam Phase I Inspection Report

This report presents the results of field inspection and evaluation of the Rustic Hills Lake Dam.

It was prepared under the National Program of Inspection of Non-Federal Dams.

This dam has been classified as unsafe, non-emergency by the St. Louis District as a result of the application of the following criteria:

1) Spillway will not pass 50 percent of the Probable Maximum Flood.
2) Overtopping could result in dam failure.
3) Dam failure significantly increases the hazard to loss of life downstream.

SUBMITTED BY: _____ _____
Chief, Engineering Division Date

APPROVED BY: _____ _____
Colonel, CE, District Engineer Date

RUSTIC HILLS LAKE DAM
JEFFERSON COUNTY, MISSOURI

MISSOURI INVENTORY NO. 30467

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

Rustic Hills Lake Dam [redacted] (MO 30467), Mississippi-Kaskaskia-St. Louis Basin, Jefferson County, Missouri. Phase I Inspection Report.

PREI

HORNER & SHIFRIN, INC.
5200 OAKLAND AVENUE
ST. LOUIS, MISSOURI 63110

FOR:

U.S. ARMY ENGINEER DISTRICT, ST. LOUIS
CORPS OF ENGINEERS

(11) SEPT[redacted]978

PHASE I REPORT

NATIONAL DAM SAFETY PROGRAM

Name of Dam:	Rustic Hills Lake Dam
State Located:	Missouri
County Located:	Jefferson
Stream:	Tributary La Barque Creek
Date of Inspection:	5 July 1978

The Rustic Hills Lake Dam was visually inspected by engineering personnel of the office of Horner & Shifrin, Inc., Consulting Engineers, St. Louis, Missouri. The purpose of the inspection was to assess the general condition of the dam with respect to safety and, based upon this inspection and available data, determine if the dam poses a hazard to human life or property.

Based on a visual inspection, the present general condition of the dam and spillway is considered satisfactory. The following deficiencies were noticed during the inspection and are considered to have an adverse effect on the overall safety and future operation of the dam and spillway:

1. A substantial cover of small trees and brush exist on the downstream slope of the dam. The tree roots may, in time, provide a pathway for lake seepage. Some seepage, as evidenced by standing water and soft, wet ground with cattails, was noticed at the toe of the downstream slope in an area near the right abutment and in an area near the center of the dam.

2. Several small trees also exist on the upstream face of the dam. Roots of these trees can also contribute to seepage.

3. A heavy growth of vegetation extending above the waterline exists in the lake at the approach to the spillway. This growth may reduce the spillway discharge since flow approaching the spillway would be impeded.

4. The upstream slope has a grass cover to protect it from erosion by wave action. However, grass cover is not considered adequate to prevent erosion by wave action for a fluctuating lake level. Loss of material can result in instability and settlement of the dam crest.

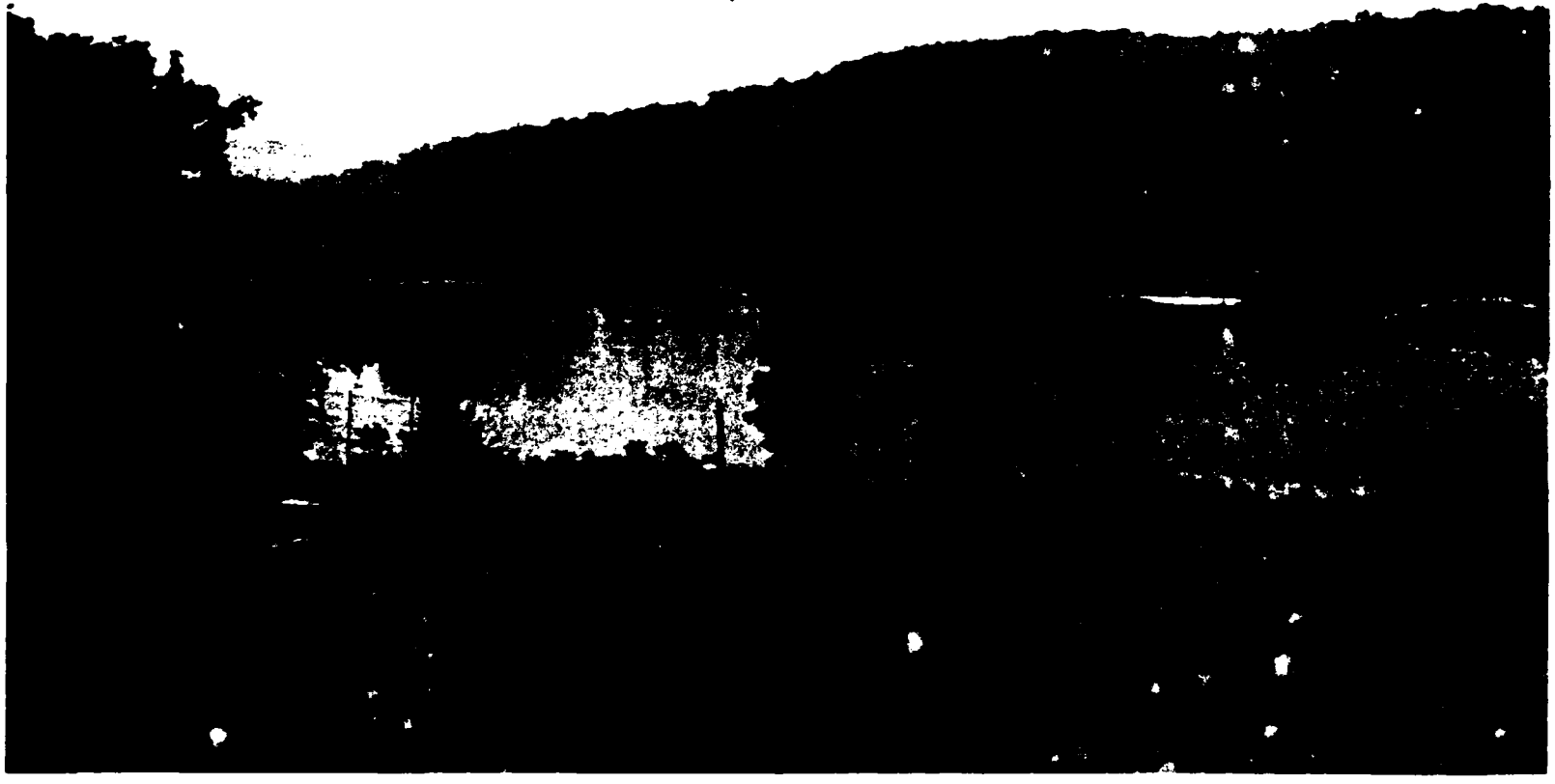
The conditions described above are not considered to be serious at this time.

According to the criteria set forth in the recommended guidelines (see text) the minimum spillway design flood for this dam, which is classified as small in size and of high hazard potential, is specified to be one-half Probable Maximum Flood (1/2 PMF). PMF is the flood that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the region. Results of a hydrologic/hydraulic analysis indicated the existing spillway to be inadequate to pass lake outflow resulting from a storm of 1/2 PMF magnitude; however, it is adequate to pass lake outflow resulting from the 1 percent chance (100-year frequency) flood. The existing spillway is capable of passing lake outflow corresponding to about 31 percent of the PMF. The length of the downstream damage zone, should failure of the dam occur, is estimated to be five miles.

A review of available data did not disclose that seepage and stability analyses of the dam were performed. This is considered a deficiency and should be rectified.

It is recommended that the owner take the necessary action in the near future to correct or control the deficiencies and safety defects reported herein.

Albert B. Becker, Jr.
P.E. Missouri E-9168



OVERVIEW OF LAKE AND DAM

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
RUSTIC HILLS LAKE DAM - ID NO. 30467

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PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
RUSTIC HILLS LAKE DAM - ID NO. 30467

SECTION 1 - PROJECT INFORMATION

1.1 GENERAL

a. Authority. National Dam Inspection Act, Public Law 92-367, dated 8 August 1972.

b. Purpose of Inspection. The purpose of this visual inspection was to make an assessment of the general conditions of the dam with respect to safety and, based upon available data and visual inspection, determine if the dam and spillway pose a hazard to human life or property.

c. Evaluation Criteria. This evaluation was performed in accordance with the "Phase I" investigation procedures as prescribed in "Recommended Guidelines for Safety Inspection of Dams," Appendix D to "Report of the Chief of Engineers on the National Program of Dams," dated May 1975.

1.2 DESCRIPTION OF PROJECT

a. Description of Dam and Appurtenances. The Rustic Hills Lake Dam is an earthfill type embankment rising approximately 36 feet above the original stream bed. Lake level is governed by an excavated earth type spillway section located adjacent to the right (looking downstream) abutment. An access road traversing the dam crest crosses the spillway control section. Below the spillway crest the outlet channel consists of a series of rock falls until it reaches a point below the dam where it joins the original stream course. At normal pool the lake surface occupies approximately 6 acres. There are no drawdown facilities for dewatering the lake.

b. Location. The dam and lake are located on an unnamed tributary of La Barque Creek, approximately 6 miles southwest of Pacific, Missouri, in Jefferson County, as shown on the Regional Vicinity Map, Plate 1. The dam is located in Section 3, Township 42 North, Range 3 East, approximately 1.5 miles southeast of the intersection of State Routes F and FF.

c. Size Classification. The size classification, based on the height of the dam and storage capacity, is categorized as small. (Per Table 1, Recommended Guidelines for Safety Inspection of Dams.)

d. Hazard Classification. According to the St. Louis District, Corps of Engineers, the Rustic Hills Lake Dam has a high hazard potential, meaning that the dam is located where failure may cause loss of life, serious damage to homes, extensive agricultural, industrial and commercial facilities, important public utilities, main highways, or railroads. The estimated flood damage zone, should failure of the dam occur, as determined by the St. Louis District, extends five miles downstream of the dam. Within the possible damage zone are three homes, two state highway bridges, and one private road bridge.

e. Ownership. The dam is owned by Mr. Forest J. Murphy, 4200 Laclede, St. Louis, Missouri, 63156. The property is commercially operated by the owner as Rustic Hills Park, a private preserve available to the public for fishing, swimming, hiking, picnicking, and camping.

f. Purpose of Dam. The dam impounds water for the purpose of recreation by the general public.

g. Design and Construction History. The dam was constructed in about 1968 by the former owners of the property, Mr. and Mrs. Francis J. Harrison. According to information provided by Mr. Harrison, the builder of the dam was the Glen R. Leonard Excavating Company, of Hillsboro, Missouri. Mr. Harrison reported that he was not familiar with the details of design or construction of the dam and that such information, if available, would have to be obtained

from the contractor, Mr. Leonard. Attempts to contact Mr. Leonard have been unsuccessful. In 1974, the property was sold to Mr. Forest J. Murphy, 4200 Laclede, St. Louis, Missouri, 63156, who at the present operates the property including the lake on a commercial basis.

h. Normal Operational Procedure. The lake level is regulated by overflow of an uncontrolled, excavated earth, spillway.

1.3 PERTINENT DATA

a. Drainage Area. The area tributary to the lake is virtually undeveloped and, in a natural state, covered with timber. The watershed above the dam amounts to approximately 155 acres. The watershed area is outlined on Plate 1.

b. Discharge at Damsite.

(1) Estimated known maximum flood at damsite ... 40± cfs(1)

(2) Spillway capacity ... 770 cfs

c. Elevation (ft above MSL). The top of a 6-inch wood post located on the dam crest near the right abutment was assumed to be elevation 638. The ground elevation at the base of the post was based on the contours, at 10-foot intervals, shown on the 1954 Pacific Missouri Quadrangle Map, 7.5 minute series, photo revised 1968. The following elevations were measured in the field using the above benchmark.

(1) Top of dam ... 635.8 (min.)

(2) Normal pool (spillway crest) ... 633.0

(3) Streambed at centerline of dam ... 600.0±

(4) Maximum tailwater ... Unknown

(1) Value computed for water surface at elevation 633.7 and based upon information supplied by an employee of the owner.

d. Reservoir.

(1) Length of normal pool (elevation 633.0) ... 1,100 ft.

(2) Length of maximum pool (elevation 635.8) ... 1,400 ft.

e. Storage.

(1) Normal pool ... 73 ac.ft.

(2) Top of dam (incremental) ... 19 ac.ft.

f. Reservoir Surface.

(1) Top of Dam ... 7 acres

(2) Normal Pool ... 6 acres

g. Dam.

(1) Type ... Earthfill

(2) Length ... 620 ft.

(3) Height ... 36 ft.

(4) Top Width ... 10 ft.

(5) Side Slopes

  (a) Upstream ... 1v on 2.8h

  (b) Downstream ... 1v on 3h

(6) Cutoff ... Unknown

(7) Core ... Unknown

(8) Slope Protection

  (a) Upstream ... Grass

  (b) Downstream ... Grass

h. Spillway ... Excavated earth at crest.

i. Outlet for Lake Drawdown ... None provided.

SECTION 2 - ENGINEERING DATA

2.1 DESIGN

No engineering data relating to the design of the dam are known to exist.

2.2 CONSTRUCTION

No records relating to the construction of the dam are known to exist.

2.3 OPERATION

The lake level is governed by an uncontrolled, excavated earth spillway. The maximum known loading on the dam, according to an employee of the owner, was a storm that produced a depth of flow at the spillway crest of about 8 inches.

2.4 EVALUATION

a. Availability. Engineering data for assessing the design of the earthfill dam and spillway were unavailable.

b. Adequacy. No data available.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS

a. General. A visual inspection of the dam and spillway was made by Horner & Shifrin engineering personnel on 5 July 1978. Also inspected at this time was the area downstream from the dam, including the juncture of the tributary with La Barque Creek and the various downstream road crossings and homes between the dam and the Meramec River. Photographs of the dam taken at the time of the inspection are included on Pages A-1 through A-3 of the Appendix.

b. Dam. The visible portions of the upstream and downstream slopes (see Photos 1 and 2) of the dam appeared to be in satisfactory condition with the exception of some minor surface erosion of the downstream slope in a cleared area near the center of the dam. A substantial cover of small trees and brush exists on most of the downstream slope. Several small trees were also present on the upstream slope. Seepage, as evidenced by wet ground and pockets of water with cattails (see Photo 5), was noticed in several areas adjacent to the downstream slope. There was no riprap protection to prevent erosion at the water line on the upstream slope. The top of dam, as determined by survey, was found to have a continuous upward slope from the spillway toward the left abutment. A profile of the dam crest extending through the spillway section is shown on Plate 2.

c. Spillway. The crest of the excavated earth spillway section was found to be in a satisfactory condition with a substantial turf cover, with the exception of the area where the access road crosses the spillway to reach the dam crest. Some erosion has occurred in this area (see Photo 3), apparently due to traffic crossing the wet ground along the roadway. Dense vegetation, to a height of about 3 feet above the waterline, was growing in the lake at the approach area to the spillway. This growth extended out into the lake about 30 feet. Beyond the control section, the outlet channel consists of a series of rock falls (see Photo 4) until it reaches the original stream

course, approximately 200 feet below the dam. A profile of the spillway channel through the control section is shown on Plate 2.

d. Downstream Channel. The downstream channel is unimproved. The stream joins the east fork of La Barque Creek at a point approximately 1 mile below the dam. La Barque Creek joins the Meramec River approximately 4.2 miles below the dam.

e. Reservoir. The area contiguous to the lake was found to be in good condition and well maintained. The bank slopes were grass covered with the exception of a beach area, located near the upstream end of the lake, used for swimming. No appreciable amount of sediment was observed in the shallow end of the lake.

3.2 EVALUATION

The deficiencies observed during this inspection are not considered of major consequence to warrant immediate remedial action.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES

The spillway is uncontrolled. The water surface level is governed by rainfall runoff, evaporation, seepage, and the capacity of the uncontrolled spillway.

4.2 MAINTENANCE OF DAM AND SPILLWAY

Based on the substantial cover of small trees and vegetation on the downstream slope of the dam, it is apparent that this area receives little attention. According to personnel operating the preserve, the grass on the upstream face of the dam and spillway crest is mowed periodically during the growing season. Cattails growing in wet areas immediately below the dam also indicate lack of concern for seepage problems and drainage of these areas. Although no evidence of animal burrows was noticed at the time of the inspection, it was reported that muskrats have been exterminated from the dam area on several occasions.

4.3 MAINTENANCE OF OUTLET OPERATING FACILITIES

No outlet operating facilities exist at this dam.

4.4 DESCRIPTION OF ANY WARNING SYSTEMS IN EFFECT

The inspection did not reveal the existence of a dam warning system.

4.5 EVALUATION

A poorly maintained dam is considered detrimental to the safety of the dam. It is recommended that maintenance on a regular basis of all areas of the dam and spillway be undertaken.

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 EVALUATION OF FEATURES

a. Design Data. Design data is not available.

b. Experience Data. The drainage area and lake surface area were developed from the USGS Pacific, Missouri, Quadrangle Map. The spillway and dam layout were developed from surveys made during the inspection.

c. Visual Observations.

(1) The excavated earth spillway section and the outlet channel are in satisfactory condition, although minor erosion of the spillway crest at the road crossing has occurred.

(2) Drawdown facilities are not provided to dewater the lake.

(3) The spillway and outlet channel are located in the right abutment. Spillway releases will not endanger the integrity of the dam.

d. Overtopping Potential. The spillway section is too small to pass the probable maximum flood or the 1/2 probable maximum flood without overtopping the dam, but it is adequate to pass the 1 percent chance (100-year frequency) flood. The results of a dam overtopping analysis are as follows:

Ratio of PMF	Q - Peak Outflow (cfs)	Max. Lake Water Surface Elevation	Height of Flow Over Dam (Elev. 635.8)	Duration of Overtopping of Dam (Hours)
0.31	770	635.8	0	0
0.50	1,365	636.5	0.7	0.4
1.0	3,300	637.8	2.0	0.8
100-Year Flood	620	635.5	0	0

The flow safely passing the spillway just prior to overtopping amounts to about 770 cfs, which is equivalent to about 31 percent of the probable maximum flood, and exceeds the 1 percent chance (100-year frequency) flood.

Procedures and data for determining the probable maximum flood, the 100-year frequency flood and the discharge rating curve for flow over the spillway and the dam crest are presented on Pages B-1 and B-2 of the Appendix. A listing of the HEC-1DB input data is shown on Pages B-3 through B-5 of the Appendix.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observations. Visual observations which adversely affect the structural stability of the dam are discussed in Section 3, paragraph 3.1b.

b. Design and Construction Data. No design or construction data relating to the structural stability of the dam are known to exist.

c. Operating Records. No appurtenant structures or facilities requiring operation exist at this dam. According to the owner, no records have been kept of lake level, spillway discharge, dam settlement, or seepage.

d. Post Construction Changes. According to the present and former owners, post construction changes were not made which will affect the structural stability of the dam.

e. Seismic Stability. Since the dam is located within a Zone II seismic probability area, an earthquake of the magnitude predicted is not expected to produce a hazardous condition to the dam, provided that static stability conditions are satisfactory and conventional safety margins exist.

SECTION 7 - ASSESSMENT/REMEDIAL MEASURES

7.1 DAM ASSESSMENT

a. Safety. Several items were noticed during the visual inspection that adversely affect the safety of the dam. These items, which exist on the downstream slope, are seepage, trees, dense brush, and surface erosion. The extent of the effect of these items can be better assessed after the trees and brush are removed.

A hydraulic analysis indicated the excavated earth spillway section to be capable of passing lake outflow of about 770 cfs without the level of the lake exceeding the low point of the dam. A hydrologic analysis of the lake watershed area, as discussed in Section 5, paragraph 5.1d, indicated that for storm runoff of 1/2 probable maximum flood magnitude the lake outflow would be on the order of 1,365 cfs, and for the 100-year frequency flood the lake outflow would be about 620 cfs.

No stability and seepage analyses of the dam or hydraulic analyses of the spillway are known to exist.

b. Adequacy of Information. Due to the lack of engineering and construction data, the assessments reported herein were based on external conditions as determined during the visual inspection. The assessment of the hydrology of the watershed and capacity of the spillway were based on a hydrologic/hydraulic study as indicated in Section 5.

c. Urgency. The items concerning the safety of the dam noted in paragraph 7.1a and the remedial measures recommended in paragraph 7.2 should be accomplished in the near future.

d. Necessity for Phase II. Based on the results of the Phase I inspection, a Phase II investigation is not recommended.

e. Seismic Stability. Since the dam is located within a Zone II seismic probability area, an earthquake of the magnitude predicted is not expected to produce a hazardous condition to the dam, provided that static stability conditions are satisfactory and conventional safety margins exist.

7.2 REMEDIAL MEASURES

a. Recommendations. The following actions are recommended:

(1) Spillway size and/or height of dam should be increased to pass lake outflow resulting from a storm of a minimum of one-half probable maximum flood magnitude.

(2) Obtain the necessary soil data and perform stability and seepage analyses in order to determine the structural stability of the dam for all operational conditions.

b. O & M Maintenance and Procedures. The following O & M Maintenance and Procedures are recommended:

(1) Remove the trees and brush from the downstream face and the trees from the upstream face of the dam. Tree roots provide a passageway for seepage that can lead to a piping condition and potential failure. The turf cover should be restored if destroyed or missing. Maintain the turf cover on the slope at a height that will not hinder inspection of the slope.

(2) Once the downstream slope is cleared of trees and brush, it should be thoroughly checked for seepage, erosion and other signs of instability. If excessive seepage flows are observed or sloughing noted, the dam should be investigated by an engineer experienced in design and construction of dams.

(3) If seepage exists, as expected, a subdrain and filter system should be installed in line with and approximately at the location of the downstream toe of slope of the dam. The size of the collector pipe should be determined on the basis of the recommended under-seepage analysis. Saturation of the soil in this area can impair the structural stability of the embankment, resulting in slides or possible failure of the dam.

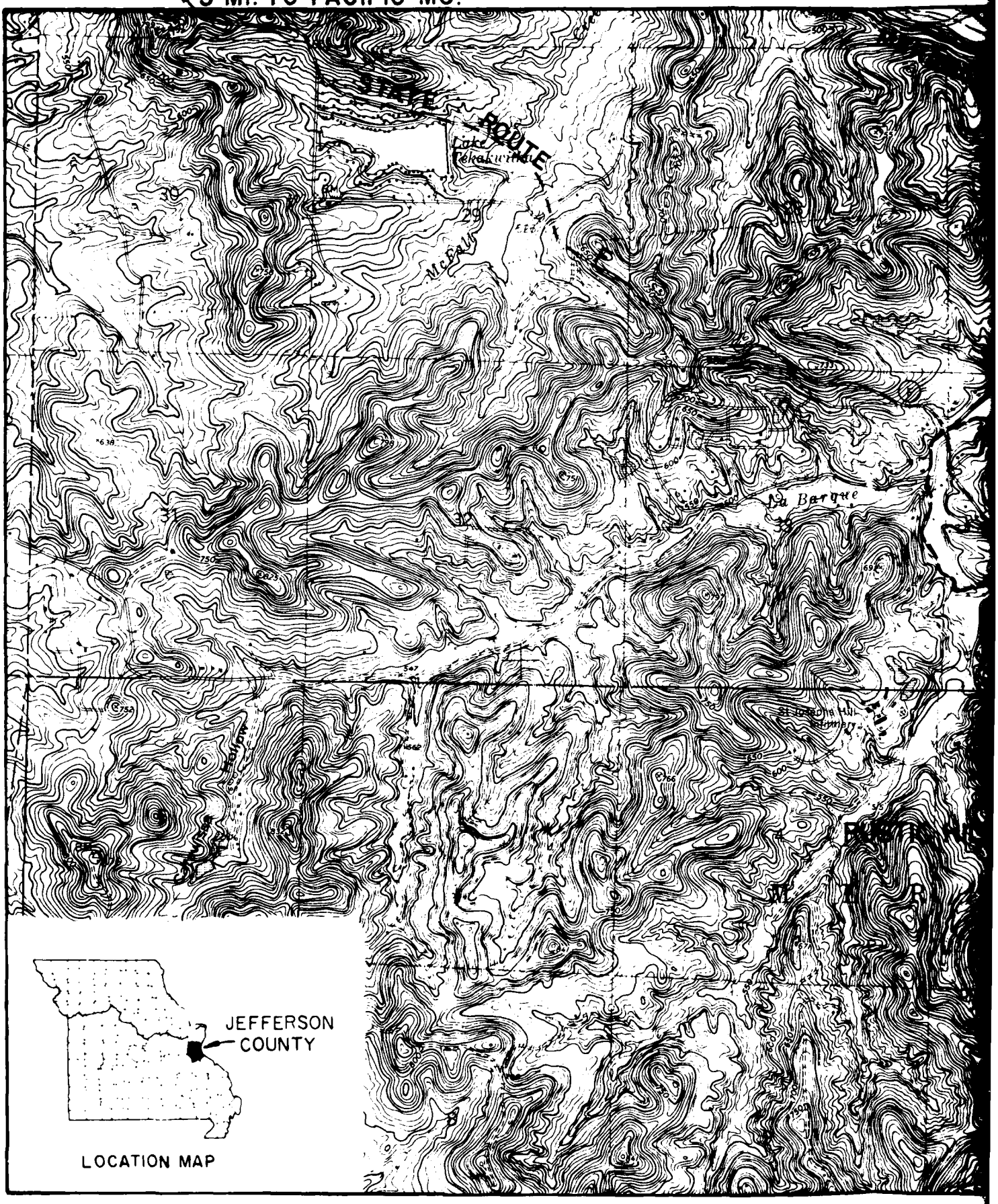
(4) Provide some form of surfacing for the roadway crossing the spillway in order to prevent erosion of the section.

(5) Provide some form of slope protection for the upstream face of the dam at and above the normal water line in order to prevent erosion by wave action.

(6) Remove dense vegetation present in lake at the approach to the spillway in order to allow flow to enter the spillway unrestricted.

(7) Provide maintenance of all areas of the dam and spillway on a regularly scheduled basis in order to insure features of being in satisfactory operational condition.

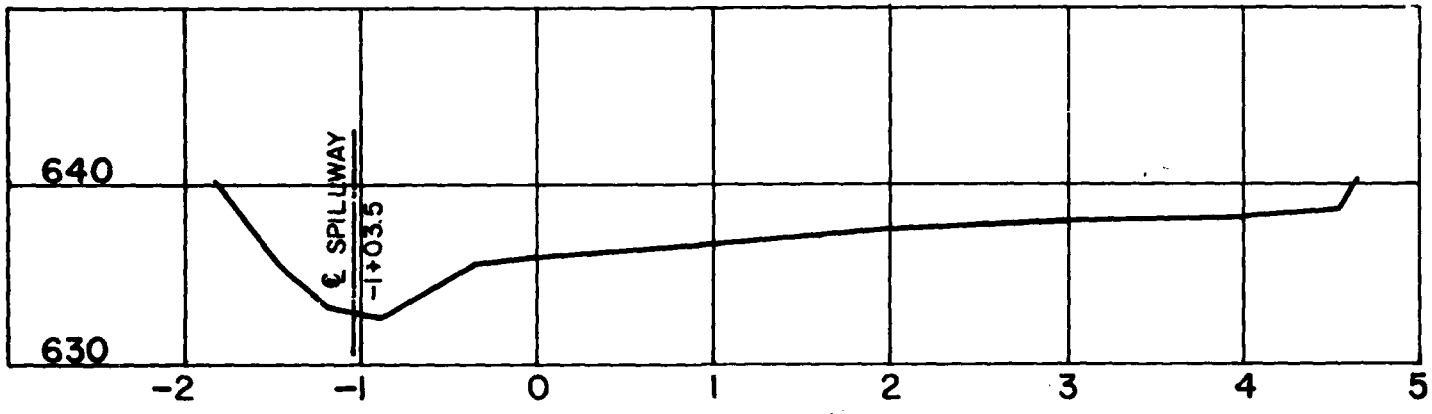
(8) A detailed inspection of the dam should be instituted on a regular basis by an engineer experienced in the design and construction of dams. It is also recommended, for future reference, that records be kept of all inspections and remedial measures.


3 MI. TO PACIFIC MO.
STATE
ROUTE
Lake Tekakwitha
McEaly
La Barque
St. Joseph Hill Cemetery
JEFFERSON COUNTY
LOCATION MAP

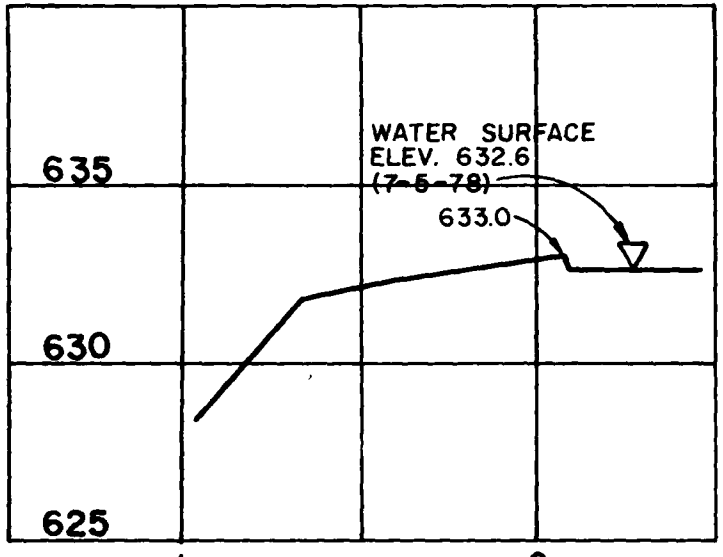
REGIONAL VICINITY MAP

PLATE 1

, 2



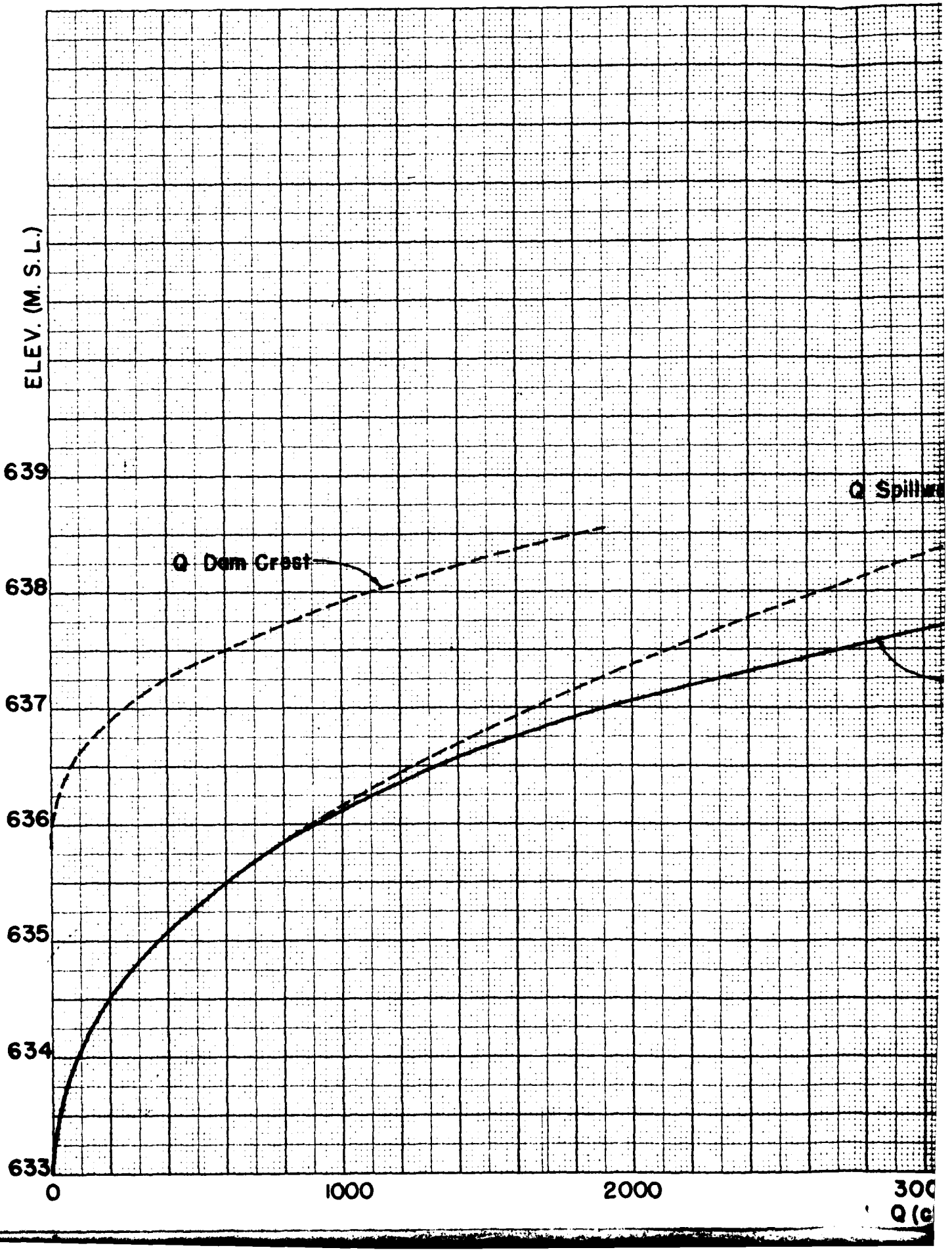
PROFILE DAM CREST
SCALES: 1"=10'V., 1"=100'H.



PROFILE SPILLWAY ℄
SCALES 1"=5'V., 1"=50'H.

RUSTIC HILLS LAKE
DAM & SPILLWAY PROFILES
Horner & Shifrin, Inc. July 1978

PLATE 2


ELEV. (M. S. L.)
639
638
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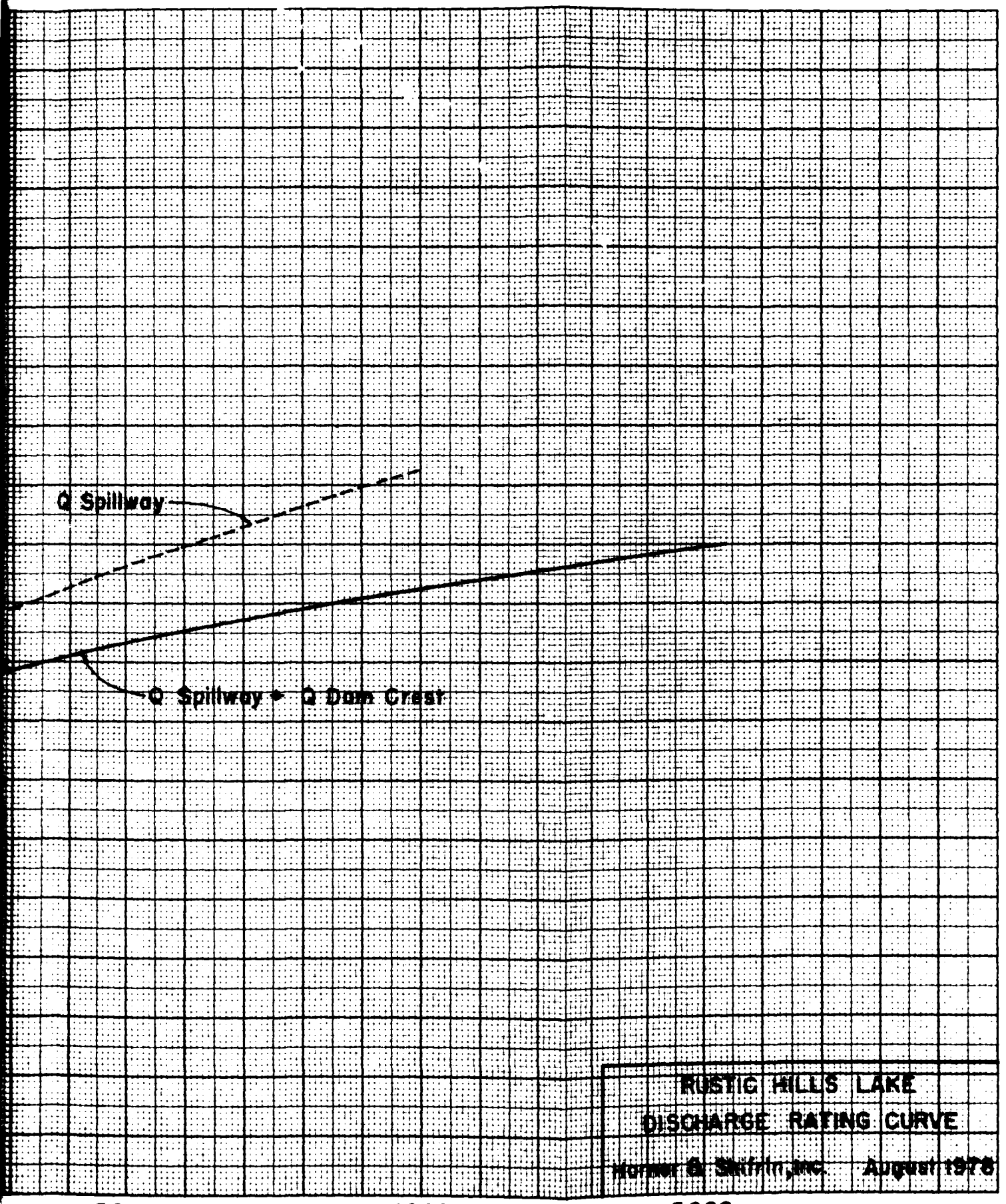
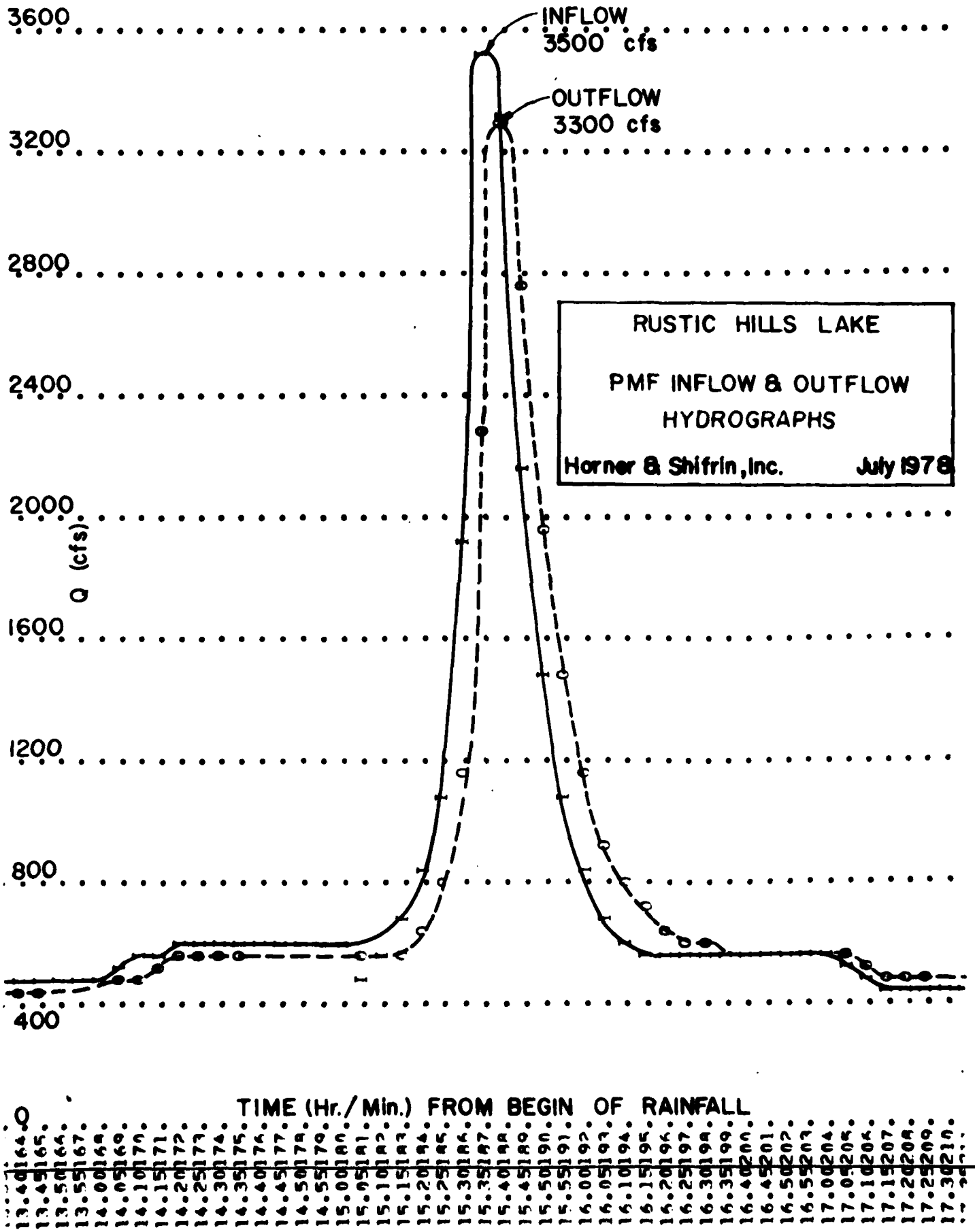


RUSTIC HILLS LAKE
DISCHARGE RATING CURVE
Horner & Skiffin, Inc. August 1978

-2

PLATE 3

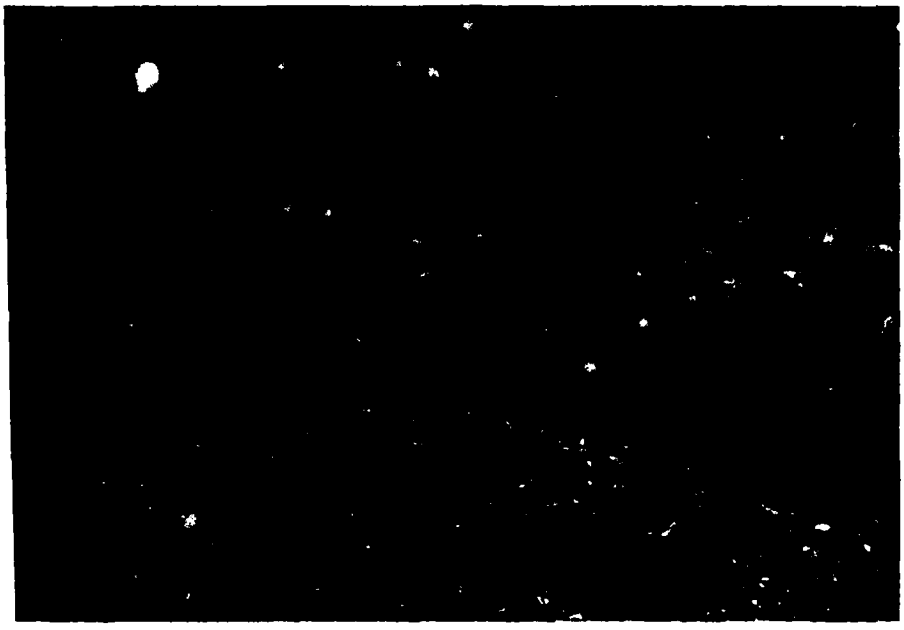
PLATE 4


INFLOW
3500 cfs
OUTFLOW
3300 cfs
RUSTIC HILLS LAKE
PMF INFLOW & OUTFLOW
HYDROGRAPHS
Horner & Shifrin, Inc. July 1978
Q (cfs)
3600
3200
2800
2400
2000
1600
1200
800
400
0
TIME (Hr./Min.) FROM BEGIN OF RAINFALL

APPENDIX

NO. 1: UPSTREAM FACE OF DAM

NO. 2: DOWNSTREAM FACE OF DAM



NO. 3: EARTH SPILLWAY

NO. 4: ROCK FALLS AT SPILLWAY OUTLET CHANNEL

NO. 5: CATTAILS AT TOE OF DOWNSTREAM SLOPE

HYDROLOGIC COMPUTATIONS

1. The HEC-1 Dam Safety Version (July 1978) program was used to develop inflow and outflow hydrographs and dam overtopping analyses, with hydrologic inputs as follows:

a. Probable maximum precipitation (200 sq. mile, 24-hour value equals 25.5 inches) from Hydrometeorological Report No. 33. One hundred year frequency (point precipitation, 24-hour value equals 7.23 inches) from U.S. Weather Bureau Technical Paper No. 40.

b. Drainage area = 0.24 square miles
= 154 acres

c. SCS parameters
Lag time = 0.08 hours
Soil type CN = 80

2. The spillway section consists of a broad-crested, approximately V-shaped excavated earth section for which conventional weir formulas do not apply.

Spillway release rates were determined as follows:

(1) Spillway crest section properties (area, a and top width, t) were computed for various depths, d.

(2) It was assumed that flow over the spillway crest would occur at critical depth. Flow at critical depth (Q_c) was computed as $Q_c = (\frac{a^3}{t}\ g)^{0.5}$ for the various depth, d.

Corresponding velocities (v_c) and velocity heads (H_{vc}) were determined using conventional formulas.

(3) Static lake levels corresponding to the various Q_c values passing over the spillway were computed as critical depths plus critical velocity head ($d_c + H_{vc}$), and the relationship between lake level and spillway discharge was thus obtained. The procedure neglects the minor insignificant friction losses across the length of the spillway.

3. The profile of the dam crest is irregular and flow over the dam crest cannot be determined by conventional weir formulas. Flow quantities overtopping the dam crest were computed as described in the preceding paragraph and corresponding flow over the dam and spillway for given elevations were added to obtain the combined outflow rating curve for the dam and spillway. This rating curve is shown on Plate 3. The inflow-outflow hydrographs for the PMF are shown on Plate 4.

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**********************************
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
  LAST MODIFICATION  3 AUG 78
**********************************
    1                 A1       ANALYSIS OF DAM OVERTOPPING USING RATIOS OF PMF
    2                 A2       HYDROLOGIC-HYDRAULIC ANALYSIS OF SAFETY OF RUSTIC HILLS DAM
    3                 A3       RATIOS OF PMF ROUTED THROUGH RESERVOIR
    4                 R     288        0        5       -0       -0       -0       -0       -0       -0       -0
    5                 R1      5
    6                 J       1        3        1
    7                 J1   0.31     0.50     1.00
    8                 K       0   INFLOW                                          3        1
    9                 K1       INFLOW HYDROGRAPH
   10                 M       1        2     0.24                               1.0                        1
   11                 P       0     25.5      102      120      130
   12                 T                                                                -1      -80
   13                 W2              0.08
   14                 X    -1.0     -.10      2.0
   15                 K       1      DAM                                2        3        1
   16                 K1       RESERVOIR ROUTING BY MODIFIED PULS
   17                 Y                                          1        1
   18                 Y1      1                                                        72       -1
   19                 Y4    633    633.5      634    634.5      635    635.5    635.8      636    636.5      637
   20                 Y4  637.5      638    638.5
   21                 Y5      0       20       85      200      370      610      770      900     1320     1910
   22                 Y5   2720     3770     5060
   23                 $A      0      5.7      9.2     14.7
   24                 $E  595.1      633      640      650
   25                 $$  633.0
   26                 $D  635.8
   27                 K      99
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**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
  LAST MODIFICATION  3 AUG 78
**********
    1                 A1       ANALYSIS OF DAM OVERTOPPING USING 100 YR FLOOD
    2                 A2       HYDROLOGIC-HYDRAULIC ANALYSIS OF SAFETY OF RUSTIC HILLS DAM
    3                 A3       100 YR FLOOD ROUTED THROUGH RESERVOIR
    4                 R     288        0        5       -0       -0       -0       -0       -0       -0       -0
    5                 B1      5
    6                 J       1        1        1
    7                 J1    1.0
    8                 K       0   INFLOW                                 3        1
    9                 K1        INFLOW HYDROGRAPH
   10                 M       0        2    0.24                      1.0                         1
   11                 O     288
   12                 O1   .007     .007     .007     .007     .007     .007     .007     .007     .007     .007
   13                 O1   .007     .007     .007     .007     .007     .007     .007     .007     .007     .007
   14                 O1   .007     .007     .007     .007     .007     .007     .007     .007     .007     .007
   15                 O1   .007     .007     .007     .007     .007     .007     .007     .007     .007     .007
   16                 O1   .007     .007     .007     .007     .007     .007     .007     .007     .007     .007
   17                 O1   .007     .007     .007     .007     .007     .007     .007     .007     .007     .007
   18                 O1   .007     .007     .007     .007     .007     .007     .007     .007     .007     .007
   19                 O1   .007     .007     .014     .014     .014     .014     .014     .014     .014     .014
   20                 O1   .014     .014     .014     .014     .014     .014     .014     .014     .014     .014
   21                 O1   .014     .014     .014     .014     .014     .014     .014     .014     .014     .014
   22                 O1   .014     .014     .014     .014     .014     .014     .014     .014     .022     .022
   23                 O1   .022     .022     .022     .022     .022     .022     .022     .022     .022     .022
   24                 O1   .022     .022     .022     .022     .022     .022     .031     .031     .031     .031
   25                 O1   .031     .031     .061     .061     .061     .061     .061     .061     .132     .132
   26                 O1   .132     .253     .253     .555     .830     .385     .253     .132     .132     .132
   27                 O1   .061     .061     .061     .061     .061     .061     .031     .031     .031     .031
   28                 O1   .031     .031     .022     .022     .022     .022     .022     .022     .022     .022
   29                 O1   .022     .022     .022     .022     .022     .022     .022     .022     .022     .022
   30                 O1   .014     .014     .014     .014     .014     .014     .014     .014     .014     .014
   31                 O1   .014     .014     .014     .014     .014     .014     .014     .014     .014     .014
   32                 O1   .014     .014     .014     .014     .014     .014     .014     .014     .014     .014
   33                 O1   .014     .014     .014     .014     .014     .014     .007     .007     .007     .007
   34                 O1   .007     .007     .007     .007     .007     .007     .007     .007     .007     .007
   35                 O1   .007     .007     .007     .007     .007     .007     .007     .007     .007     .007
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34   O1   .007    .007    .007    .007    .007    .007    .007    .007    .007    .007
35   O1   .007    .007    .007    .007    .007    .007    .007    .007    .007    .007
36   O1   .007    .007    .007    .007    .007    .007    .007    .007    .007    .007
37   O1   .007    .007    .007    .007    .007    .007    .007    .007    .007    .007
38   O1   .007    .007    .007    .007    .007    .007    .007    .007    .007    .007
39   O1   .007    .007    .007    .007    .007    .007    .007    .007    .007    .007
40   O1   .007    .007    .007    .007    .007    .007    .007    .007
41   T                                                     -1      -80
42   W2           0.08
43   X   -1.0     -.10    2.0
44   K      1      DAM                      2       3       1
45   K1          RESERVOIR ROUTING BY MODIFIED PULS
46   V                                    1       1
47   Y1     1                                             72      -1
48   Y4   633     633.5     634     634.5     635     635.5   635.8   636     636.5     637
49   Y4 637.5     638     638.5
50   Y5     0      20      85      200     370     610     770     900     1320      1910
```



```
51   Y5  2720     3770     5060
52   $A     0      5.7      9.2     14.7
53   $E 595.1     633      640      650
54   $$ 633.0
55   $D 635.8
56   K     99
```